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## 3D Printing on the Moon: Challenges and Opportunities

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## **Moon 2020 - 2030**

A New Era of Coordinated Human and Robotic Exploration

ESTEC, Noordwijk, The Netherlands, 15-16 December 2015



### **3D PRINTING ON THE MOON: CHALLENGES AND OPPORTUNITIES**

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Through exploring and exploiting links between the fields of the Built Environment and Planetary and Space Sciences through interdisciplinary research, there is an opportunity to usher in a new era of architectural and constructional activities on the Moon over the next few decades. We have assembled a research consortium with members from academia and industry, especially those representing small and medium enterprises (SMEs) in the UK and EU, to support the ESA's human exploration strategy to the Moon as a stepping-stone to Mars exploration. The consortium aims to address the following key research questions:

- 1) How best to support long-term human activities during scientific exploration and settlement on other extra-terrestrial bodies such as the Moon and Mars, with hostile and extreme environments?
- 2) How best to utilise local resources on other extra-terrestrial bodies for construction purposes?
- 3) How best to use additive manufacturing (AM, a.k.a. 3D Printing) to modify conventional construction processes for practical use on other extra-terrestrial bodies?
- 4) How can the knowledge and expertise gained through the research on extra-terrestrial construction processes contribute to enhancing the quality of life on Earth?

Some of the challenges in developing a suitable 3D printing protocol includes current unknowns about the physical and chemical properties of material on the lunar surface that are suitable for 3D printing, role of nanophase Fe, effect of lunar environment on mechanical operation and material curing, issues related to scaling-up processes, presence or absence of a binder etc. In order to overcome these challenges or mitigate risks, the consortium is developing a set of criteria for construction processes and techniques that can be applied on the Moon.

If successful, the consortium will position UK/EU academics and industry at the forefront of 3D-printing application for construction processes in extra-terrestrial settings – a field likely to expand exponentially, given the growing worldwide interest in Solar System exploration.

**Keywords:** extra-terrestrial construction process, space architecture, additive manufacturing